Runway Incursion Prevention System

Joint University Program

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Project Sponsor: FAA, NASA

Presentation Overview

- **Definition of Runway Incursion.**

- **Motivation for the Runway Incursion Prevention System.**

- **Results to Date.**

- **Future Research.**

What is a Runway Incursion?

According to the FAA a Runway Incursion is defined as:

"Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground, that creates a collision hazard or results in the loss of separation with an aircraft taking off, intending to take off, landing, or intending to land."

FAA Report # AV-1998-01

NOTE: Definition only valid for airports with a control tower.

NASA Addition to Runway Incursion Definition

- **NASA includes runway transgressions into their definition of runway incursions.**

  » **A transgression is a type of runway incursion involving only one vehicle.**

- **A transgression takes place if an aircraft wanders onto an active runway without authorization, but does not interfere with another aircraft.**

Motivation for the Runway Incursion Prevention System

- **Runway Incursions are listed in the National Transportation Safety Board's "Most Wanted List" of safety improvements.**

- **Surface movement has increased due to the rise in airport traffic.**

- **Airport facilities need to increase safety.**
  - » **From 1972 to 1997 there were 719 deaths and 20 aircraft lost due to runway incursions.**

NTSB website

Runway Incursion Categories

- **Pilot Deviations**
  - » **An incursion caused by any pilot that violates FAA regulations with regards to Air Traffic Control directions.**

- **Operational Deviations**
  - » **An incursion caused by the failure of Air Traffic Control to maintain proper aircraft separation.**

- **Vehicle/Pedestrian Deviations**
  - » **An incursion caused by any vehicle or pedestrian which strays into an active runway without authorization from Air Traffic Control.**

The Runway Incursion Prevention System (RIPS)

- **The RIPS program was developed by NASA in response to the growing problem of runway incursions.**

- **This is a cooperative effort involving NASA, the FAA, industry, and universities.**
  - » **OU is involved with the LAAS segment of RIPS.**

- **Uses existing technology in such a way to alert aircraft of obstacles in their path.**

Airborne Equipment
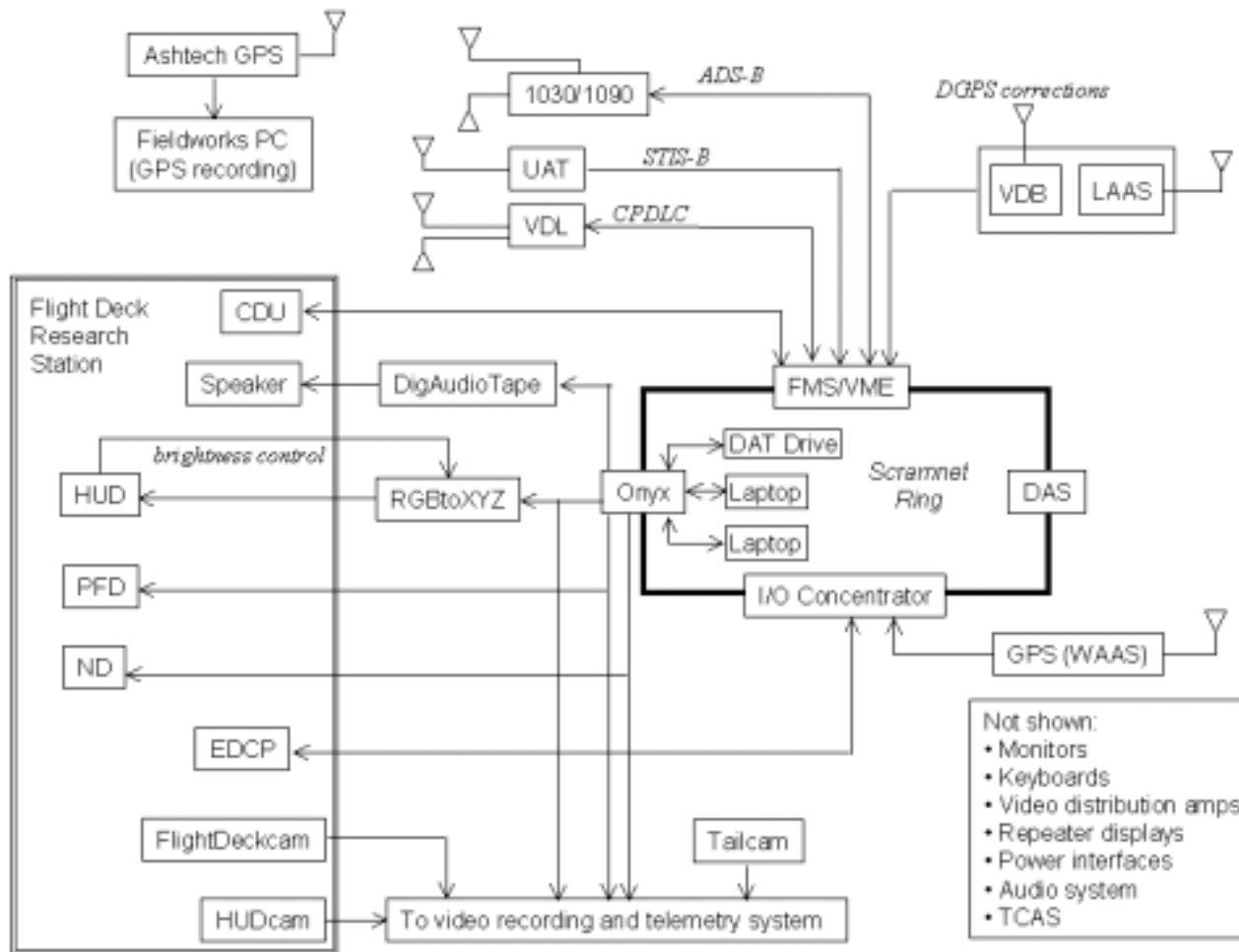
NASA RIPS POT

Collins MMR/ADS-B Pallet

- **Multi-Mode Receiver (MMR)**
  - » **Contains a hardware and software capable of receiving GPS and VHF broadcasts.**
  - » **Uses GPS and differential corrections to calculate user position for all phases of flight.**

- **Automatic Dependent Surveillance and Broadcast (ADS-B)**
  - » **Requires no outside stimulus.**
  - » **Dependent upon the MMR for position information.**
  - » **Broadcasts position data and aircraft ID via a 1090MHz transponder squitter used for aircraft surveillance.**

Simplified Block Diagram of RIPS/ADS-B
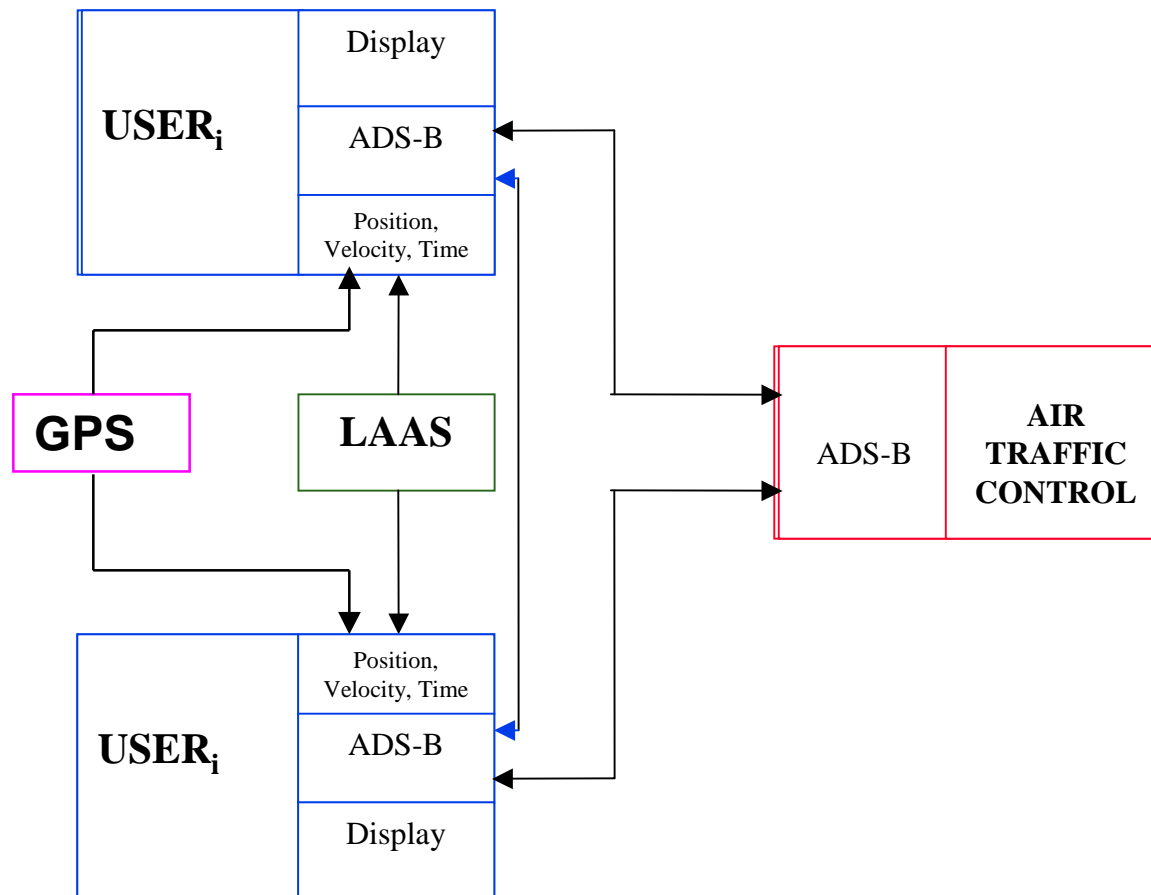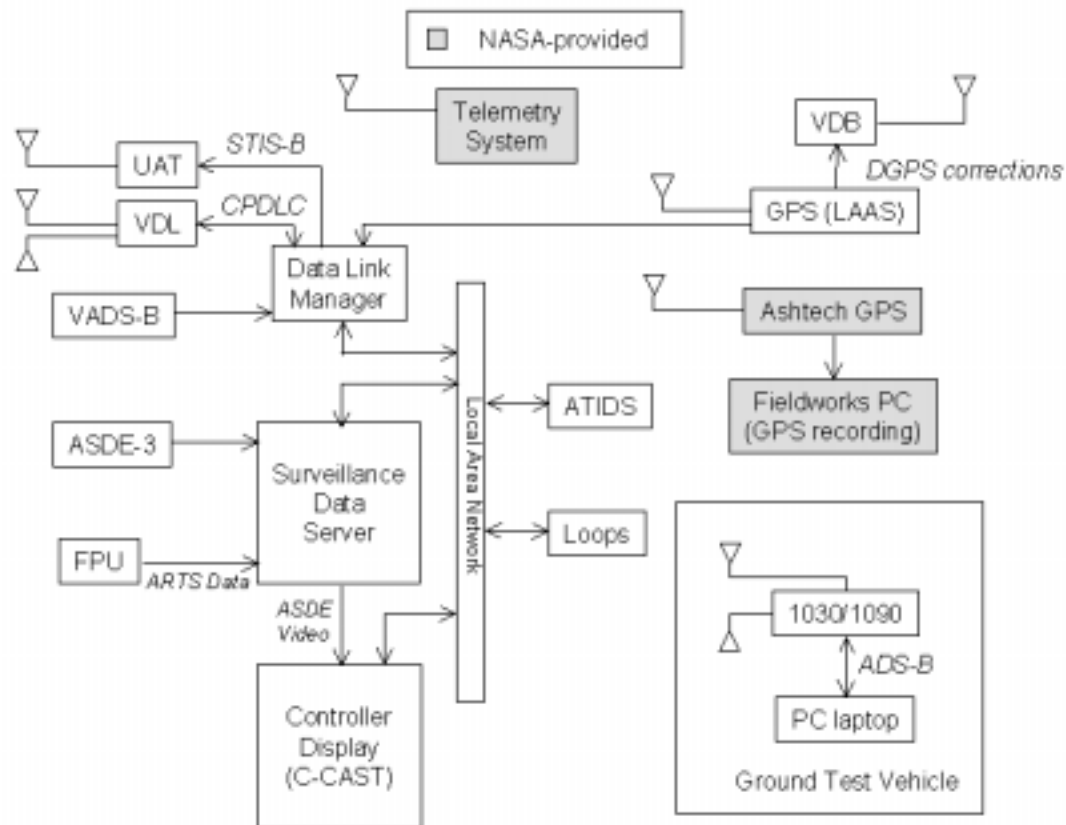
Example of User Display

HUD Guidance

Electronic Moving Map

NASA RIPS POT

FAA Ground System

NASA RIPS POT

Avionics Engineering Center's Role in RIPS

The Avionics Engineering Center (AEC) performs the following functions:

- » **Provide LAAS ground station.**
- » **Provide expertise in LAAS.**
- » **Assess LAAS performance:**
  - ▪ **LAAS position accuracy.**
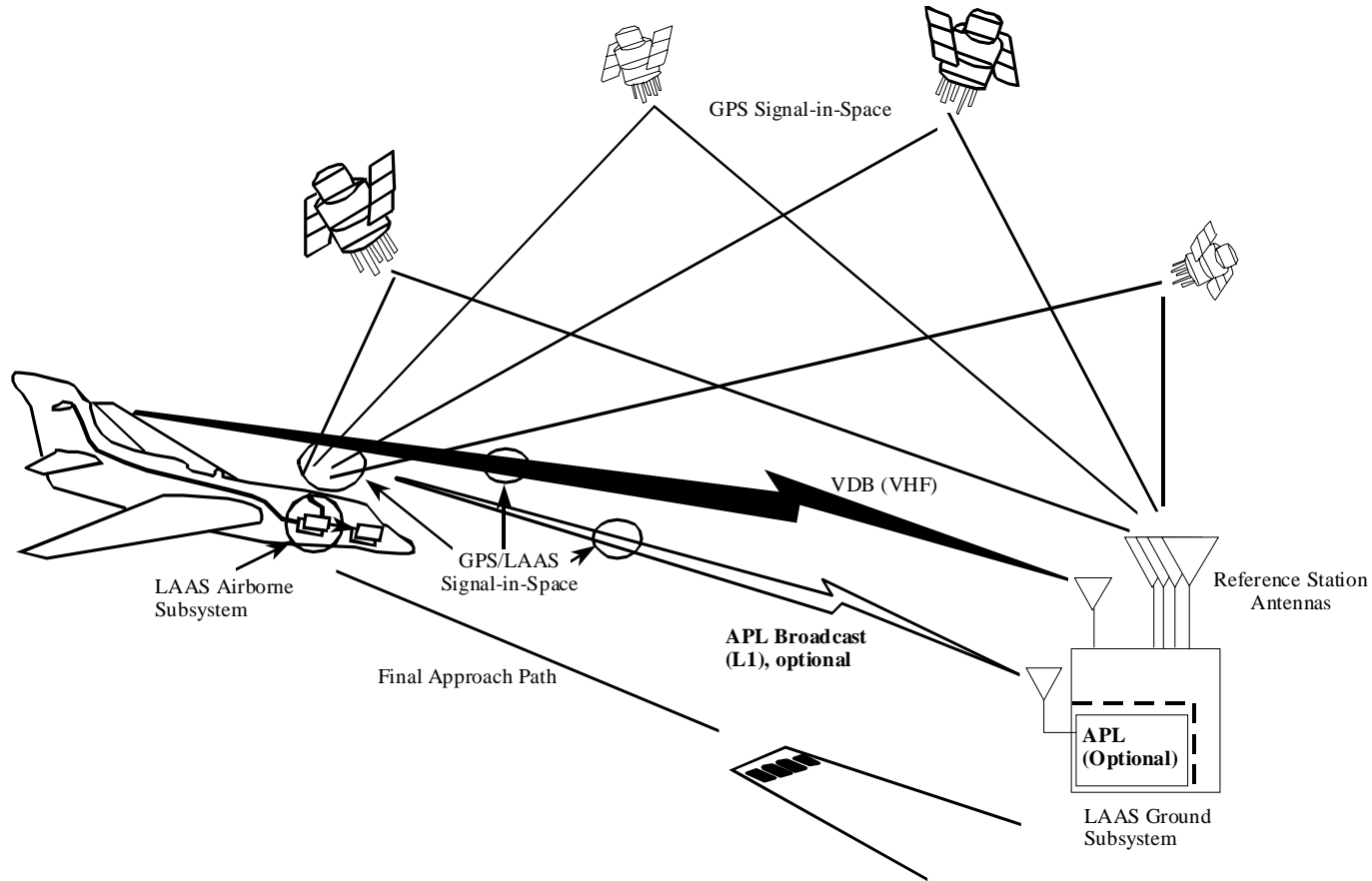 - ▪ **VDB coverage and continuity.**

Local Area Augmentation System

- **Provides differential corrections for GPS users in the local area around the airport.**

- **Uses known ground station position to calculate the differential range corrections.**

- **The differential corrections are transmitted by the LAAS ground facility (LGF) via a VHF data broadcast (VDB).**
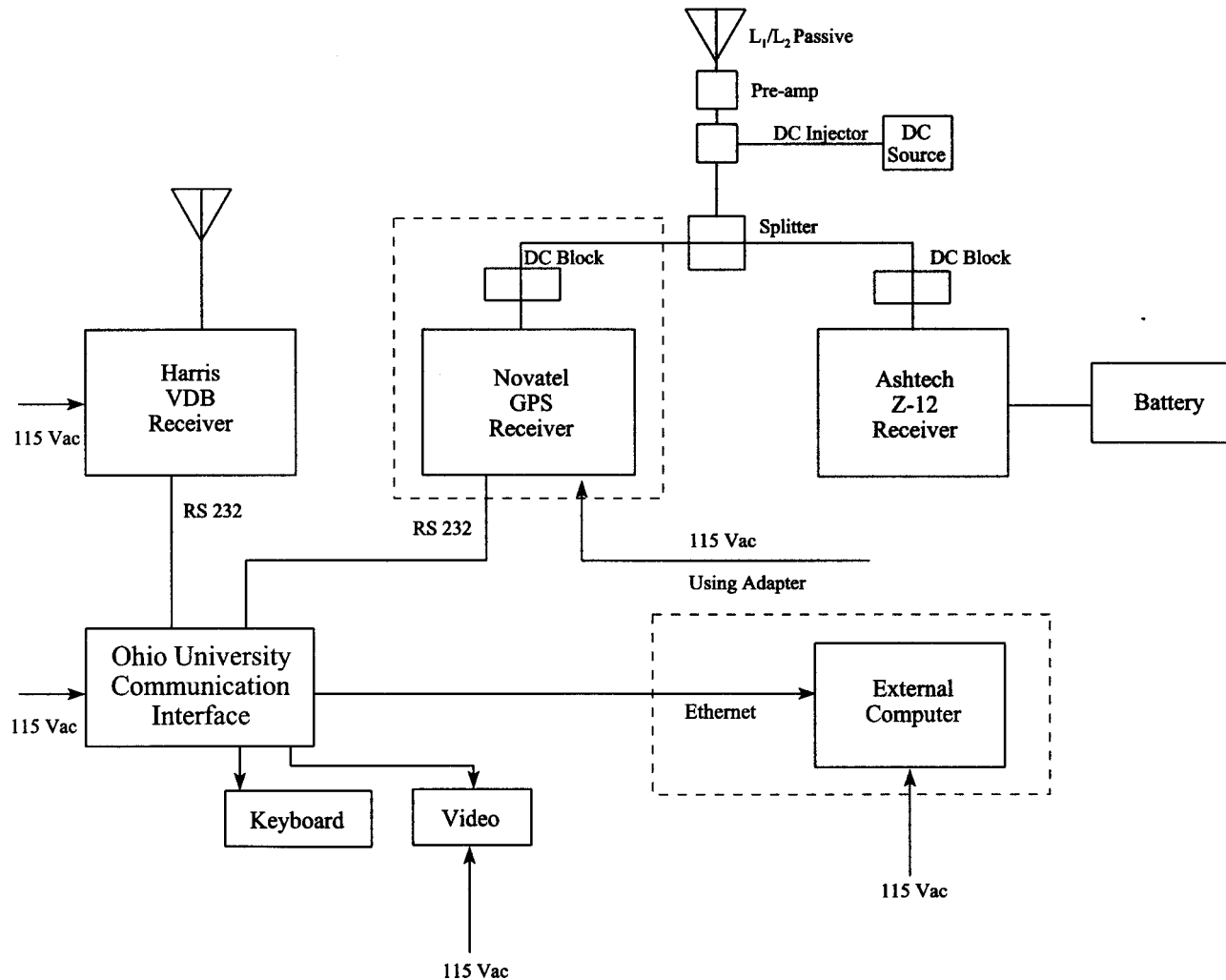
Local Area Augmentation System

GPS Signal-in-Space
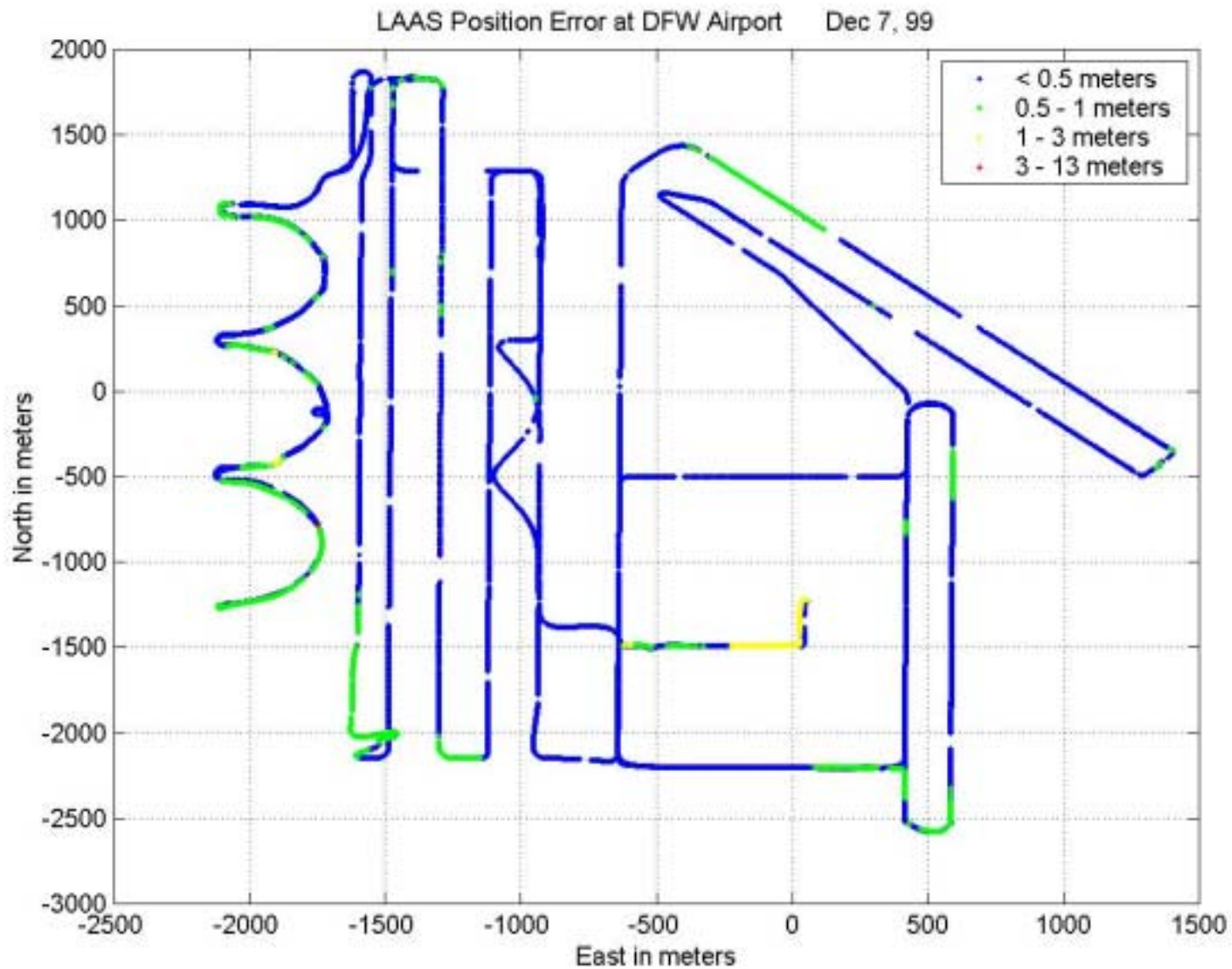
VDB (VHF)

GPS/LAAS Signal-in-Space

Reference Station Antennas

APL Broadcast (L1), optional

LAAS Airborne Subsystem

Final Approach Path

APL (Optional)

LAAS Ground Subsystem

Avionics Van Testing

- **OU van used as a surface vehicle during the RIPS testing.**
- **Van testing conducted in order:**
  - » **Determine LAAS accuracy.**
  - » **VHF data broadcast signal coverage.**
- **Van was outfitted with both GPS and VHF receivers.**
- **Initial testing of RIPS has shown some interoperability problems between the LGF and the MMR.**
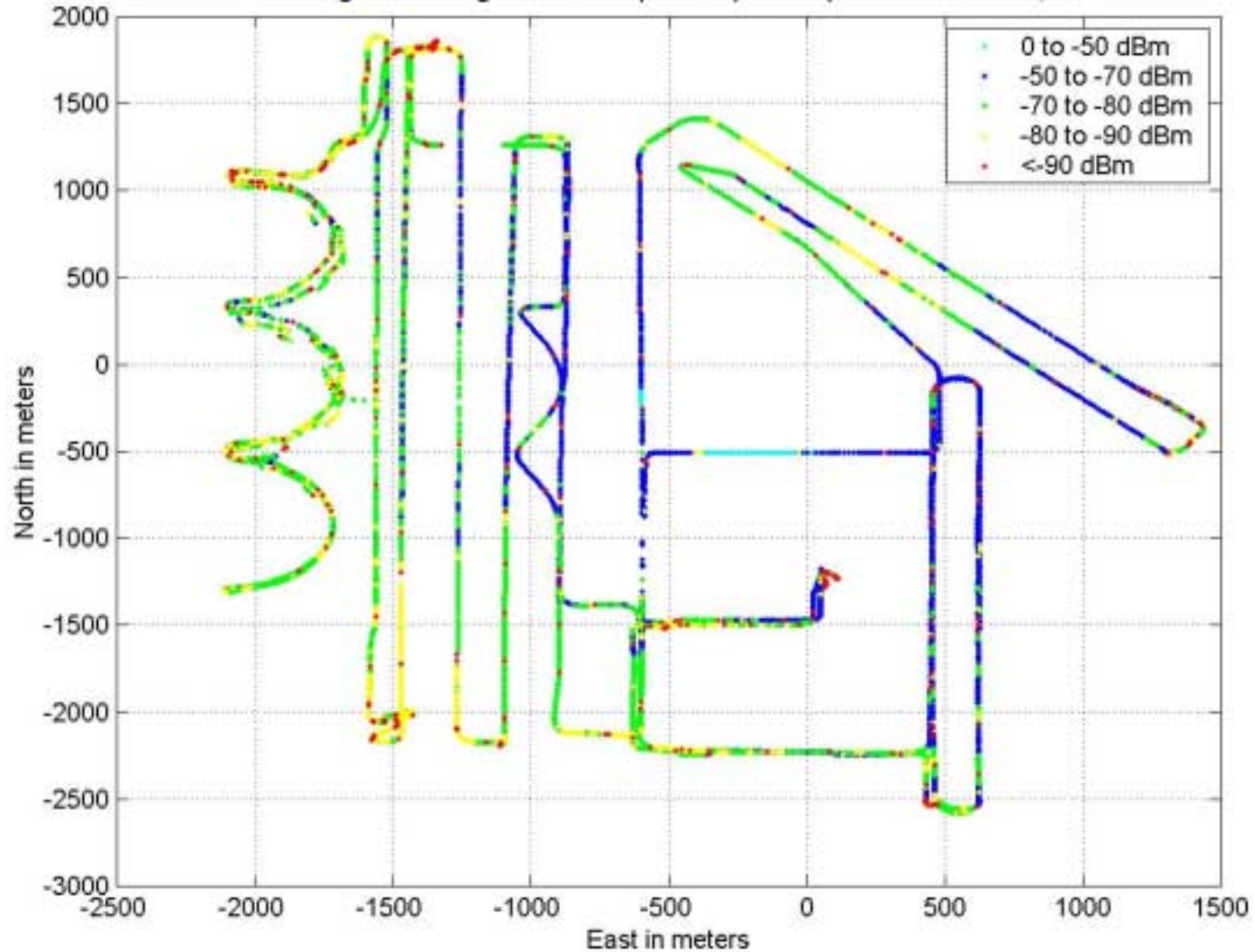
LAAS Position Error at DFW Airport   Dec 7, 99

Legend:
- < 0.5 meters
- 0.5 - 1 meters
- 1 - 3 meters
- 3 - 13 meters

North in meters (y-axis: -3000 to 2000)
East in meters (x-axis: -2500 to 1500)

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VDB Signal Coverage at DFW Airport   Open Loop Position   Dec 7, 99

Legend:
- 0 to -50 dBm
- -50 to -70 dBm
- -70 to -80 dBm
- -80 to -90 dBm
- <-90 dBm

X-axis: East in meters
Y-axis: North in meters

Future Study on the Interoperability between LGF and MMR

- **LGF and MMR have been independently manufactured and both designed to RTCA specifications.**

- **Interoperability issues have occurred during testing periods.**
    - » **Inconsistent use of Earth rotational corrections.**
    - » **Inconsistent use of altitude reference (geoid vs. ellipsoid).**

- **Perform detailed data analysis to assess LGF adjustments made for the interoperability issues.**

- **Research into these phenomena are to be conducted by the Avionics Engineering Center.**

- **Determine the readiness of LAAS for airport surveillance and guidance systems.**

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ANY QUESTIONS?